

# Trend Analysis of Human Resources Development Representing the Base for Researchers in Selected Economies

▪ *Lelek Tomáš*

## Abstract

This paper discusses the issue of precondition for the number of researchers as an important input factor for research and development (hereinafter 'R&D'). R&D is one of the main sources for new knowledge creation through human capital. It can be seen as one of the most important sources of competitiveness.

There was an analysis carried out on higher education graduates, who can be considered a base of a group of researchers, and the number of inhabitants. A method such as regression analysis for empirical data variables dependence was used. An assessment of quantitative indicators related to the number of inhabitants and the number of higher education graduates was performed by regression analysis. An analysis on higher education graduates and the number of inhabitants was conducted with the same method.

These variables were examined for the European Union, the USA and the Czech Republic in the first decade of the 21st century. Based on the analysis values of all variables, a comparison of the countries was carried out.

*Keywords: higher education graduates, research and development, researchers, knowledge- economy, EU, USA, Czech Republic.*

*JEL Classification: O20, I230*

## 1. INTRODUCTION

The companies as well as representatives of households meet the competition in the markets of goods and services as well as factors of production, which they have to face. They have to reach certain degree of competitiveness.

The word competitiveness can be explained by following words. These are the competition and the ability. The competition means rivalry and word ability can be explained as ability of competitors an indeterminate degree of success possible within the rivalry.

Competitiveness can be viewed from different perspectives. The first perspective is macroeconomic view.

Two main sources of competitiveness can be inter alia identified in terms of development and changes in the economy since the second half of the 90th years of 20th century. These include information and communication technology (furthermore ICT) and increasing importance of human resources.



Equipping enterprise with modern ICT as well as capital goods can currently be relatively easy due to their availability. Using ICT can reduce the cost of running businesses and represent a powerful tool in the research and development (furthermore R&D). ICT alone do not directly contribute to the strengthening of competitiveness, because it depends more on people and their capabilities, and the way how they use them (Lelek, 2009b, p. 74).

Microeconomic view on competitiveness sees human resources as a unique production factor. Their contribution can be seen in rationalization and innovative approach to business processes and supply. It could be commercialized in the form of the product or service. These innovations can often emerge almost spontaneously, but usually basic or applied R&D is necessary for their development.

It can be seen that the importance of human resources is growing as the source of competitiveness in terms of corporate or national economy.

The article objective is based on human resources importance in the knowledge economy, in which represents one of the main sources of competitiveness, especially in the area of R&D.

## **2. THEORETICAL BACKGROUND**

### **2.1 Intellectual capital definition and structure**

Lynn classifies enterprise capital into three categories, which are physical capital, financial capital, and intellectual capital. Among them, intellectual capital can be further divided into three parts, namely human capital, relational capital, and structural or organizational capital. The main function of intellectual capital is to convert organizational knowledge into value (Lynn, 1998).

Recent managerial literature suggests intellectual capital as a key driver of sustainable competitive advantage in that it contributes to improve company performance. (Stahle & Hong, 2002; Tayles et al., 2007).

The intellectual capital which has replaced the traditional production elements becomes the most important strategic resources of enterprise, in knowledge economy (Hu & Wang, 2012).

Stewart (1998) defines intellectual capital as the intellectual materials that can be used to create wealth, knowledge, information, intellectual property, and experience. Intellectual capital is defined as the sum of all knowledge firms utilize for competitive advantage (Subramaniam & Youndt, 2005).

In general, intellectual capital can be classified into two major categories of human capital and structural capital, and structural capital can be further divided into two subcategories of organizational capital and customer capital, as proposed by Edvinsson and Malone (1997).

### **2.2 Human capital and human resources**

Human capital is a part of intellectual capital. Intellectual capital depends on employees. As a matter of fact, intellectual capital creation and development principally reside in the actions and capabilities of employees (Roslender & Fincham, 2001; Roslender et al., 2006); (Stahle & Hong, 2002; Roos et al., 2005; Tayles et al., 2007). Human capital can be regarded as the skills, knowl-

edge, and abilities, employees use to accomplish their work and organizational objectives (Penning et al., 1998; Youndt & Snell, 2004). It can be concluded that human resources or employees are currently considered as representative of the so-called human capital.

### 2.3 Identifying the needs of the human resources in knowledge economy

A key characteristic of a knowledge economy is the shift from an economy dominated by tangible assets to one that is based on intangible, knowledge-based assets, which consist primarily of human capital and innovation (Trauth, 2012).

Globally, knowledge has become the most important factor in economic development and knowledge assets are considered essential for economic growth, competitive advantage, and human development and quality of human life (Malhotra, 2003). Research conducted by the OECD has found that the quality of workers' skills and knowledge has a significant impact on the economic and social future of developed nations such as Australia (Organization for Economic Cooperation and Development, 2003).

Knowledge as one of the attributes of human capital, are due to the so-called knowledge economy, considered as one of the key sources of the economy. The knowledge economy is a subset of the so-called new economy, because its concept implicitly includes a knowledge-based economy (Baláz & Verček, 2002).

Both economies have nearly identical basic elements, which are important for their working. Author of this article developed the new economy model and simulations under this model has emerged sufficient number of human resources as a key prerequisite for its working (Lelek, 2009a, p. 146).

In the knowledge economy, knowledge-based capabilities are the key to competitive advantage. At the firm level, this places the enterprise's people, their knowledge and innovative capacity at the heart of strategic potential, and organizations that excel in attracting, creating, managing and sustaining knowledge capabilities are advantaged (Whicker & Andrews, 2004).

### 2.4 Human capital and its importance for innovation

According to the resource-based view, the extent of valuable internal resources an organization possesses determines its innovation performance. That is, an organization endowed with the most advanced technology but lacking in talented employees may still not be able to achieve a sufficient level of innovation to afford it competitive advantage (Wang, 2013).

This assertion corresponds with Barsh's (2008) claim that human assets really promote innovation, such that human capital is the primary source of value creation and any critical innovation infrastructure in high-technology firms (Wright et al., 2007). Hence, an organization's innovation performance is rooted in its human capital, which cannot be replicated or transferred (Graeme, 2009).

### 2.5 Tertiary education absolvents and their abilities

The quality of human resources can be very different and depends on many factors. One of these factors, which are assumed as very important condition, is attained education, especially tertiary education.

Education at a Glance shows, but also has an impact on income from employment. On average, the relative earnings of tertiary-educated adults is over 1.5 times that of adults with upper secondary education, while individuals without an upper secondary education earn 25% less, on average, than their peers who have attained that level of education. And tertiary education lowers potential of unemployment for people with this education (Organization for Economic Cooperation and Development, 2013b).

The high educational level of the work force at an early date not only affects overall attainment levels, it also gave these countries a head start in many high-skill areas. This first-mover advantage is likely to have been particularly important for innovations and adaptation of new technologies,” the report said, referring in particular to the US and Japan which account for almost half of the developed world’s tertiary educated individuals (Organization for Economic Cooperation and Development, 2010).

Tertiary education graduates should have better abilities for knowledge active using and solving complex problems. Moreover they should have stimulated interest and obtained basic procedures for scientific work.

The human resources in research and technology ‘core’ – which is made up of people within science and technology occupations who possess a tertiary level education (for example, university graduates) – amounted to 44.3 million persons in 2011 across the whole of the EU-27, or just over one fifth (20.5 %) of the total number of persons employed (Eurostat, 2012).

### **3. RESEARCH OBJECTIVE AND METHODOLOGY**

Main article objective is established in accordance with the importance of R&D resulting from theory and strategic documents of the EU, e.g. “Europe 2020” (European Commission, 2013). It is trend analysis of human resources, which are supposed to create base for group of researchers.

Main objective is developed by using of two sub-objectives. The first one is an analysis of the tertiary education graduates number. It is included in the following hypotheses HA0: „The number of tertiary education graduates in the whole economy rises in monitored period.”

The second one concerns the relationship between tertiary education graduates and the number of researchers. Hence hypothesis is formulated HB0, as follows: “With increasing of the tertiary education graduates number, number of researchers increases too in monitored period.”

#### **3.1 Entry data**

Therefore input data are taken as empirical values of the variables from the available statistical survey for examining economies. Data for all variables come from the most recent statistical survey. Unfortunately there are no more recent data for some variables (e.g. number of researchers) than in 2009. Therefore, the results of the validation of hypotheses relate mainly to the first decade of the 21st century. It can be expected due to the nature of these variables related to slowly demographic changes or the number of graduates, which further development in several years, will be similar to the trend of the time series formed by empirical data.



These economies such as EU (27), USA and the Czech Republic are chosen for analysis due to follows reasons. USA and EU (27) are, instead of mutual foreign trade and the steps leading to the establishment of a transatlantic free trade zone, competitors. In the first decade of 21st century there has been perceptible production shift from these examined economies to countries in Southeast Asia. Rapid assimilation of production processes and technological equipment manufacturing has been achieved in those countries.

USA and EU (27) are similar in basic indicators such as number of inhabitant and economic performance, therefore are suitable for comparison. The Czech Republic has similar birth rate and mortality with the EU (27). It is chosen for secondary comparison of examined variables with the EU.

It can be expected from this perspective that these economies has been left with innovation, design and operation of high value-added (production of hi-tech or specialized services) as the main tool of competitiveness. Based on this assumption, the USA and EU (27) would be rivals in these fields. The Czech Republic is according to its state of economic development and EU membership in similar situation.

Due to the exclusion of possible duplication of data between the Czech Republic as the EU (27) member, EU (26) is created. Absolute values of individual variables for EU (26) is calculated by subtracting the Czech Republic values from the EU (27) values.

### 3.2 Used methods

To analyze the empirical data, tools for time series analysis is used. It is the examination of the development trend for variables time series by a selected position indicator, especially geometric average of annual growth rates. The reason for choosing this indicator is a representation of time series using a single value and the geometric mean is used to calculate the average growth time series (Hindls, Hronová, Seger & Fisher, p. 33, 2007).

Annual growth rates and geometric average of annual growth rates are calculated by the following formulas according to (Hindls, Hronová, Seger & Fisher, p. 253, 2007).

$$K_t = \frac{Y_t}{Y_{t-1}}, t = 2, 3, \dots, n. \quad (1)$$

$$\bar{K} = (K_2 K_3 \dots K_n)^{\frac{1}{n-1}}. \quad (2)$$

To verify the theoretical assumptions, according which variables entering both hypotheses are given into a relationship, correlation analysis of time series variables is used. The aim is to determine whether variables have with each other functional dependency.

Correlation coefficient is used in order to determine the nature and interdependence. This can be obtained by adjusting the calculation of the index of correlation, which we use to measure the tightness according to any regression function (Hindls, Hronová, Seger & Fisher, 2007).

The ratios of variables are used for purpose of comparison. This type of indicators is also commonly used in business practice, e.g. in the financial analysis.

The values of ratios in individual years are graphically displayed for all selected economies. Trend lines are interspersed in order to assess the development of these values. Sufficiently high

determination index is an important prerequisite for the correct regression model selection. Determination index shows how many percent of time series data variability is explained by selected regression model (Hindls, Hronová, Seger & Fisher, 2007).

In the case of linear regression, displayed data are approximated by a straight line in the following form:  $y = ax + b$ . The rate of growth or decline, based on the slope of the regression line, which is represented by member „a“, can be assessed and then compared between selected economies.

## 4. RESULTS

### 4.1 Identify the factors influencing the examined variables

The issue of human resources is in itself very complex. The author firstly examines the variables within the set of hypotheses. In addition, these variables are influenced by other factors. This is essentially a demographic factors and factors related to the educational system. From the group of possible factors affecting the number of tertiary education graduates are chosen factors corresponding with the population development and demand for tertiary education.

### 4.2 Population development

Population development is the result of natural recovery of the population (birth and mortality) and migration (Central Intelligence Agency US, 2013).

**Birth rate** and its geometric average of number of births per woman in the period 2000 - 2009 represents a value of 1,50 for the EU (26), the Czech Republic 1,20 and USA 2,07. USA has better projection for growth of children's number. It is precondition for emanating tertiary education graduates (Central Intelligence Agency US, 2013).

**Mortality** is reported as the average annual number of deaths in a given year per 1000 inhabitants. The values for the ratio of deaths to the total population of the whole in each year are calculated on the basis of reported variable values (Central Intelligence Agency US, 2013).

The geometric mean of the proportion of deaths to the total population for the period 2000 - 2009 is examined for selected economies as follows. In the EU (26) it is 1,013 %. Value for the Czech Republic is similar to EU of 1,069 %. USA has the smallest mortality of 0,844 %, which is less than one percent. Influence of the mortality can be considered, in terms of values around 1% of deaths in the population, as similar for all selected economies.

**Migration** is represented by the rate of net migration is the difference between the number of people who immigrated and moved out of the country in a given year per 1000 inhabitants (Central Intelligence Agency US, 2013).

These values are for purpose of comparison further converted into share of net migrants in the total population of the economy. Geometric average of this value is in the period 2000 - 2009 for the EU (26), and 0,146 % for the Czech Republic 0,100 % and the USA 0,347 %. The value for the USA is more than twice of the net migration in EU (26) and more than tripled compared to the Czech Republic.

Population of the USA has been most affected by the migration in the period. Immigrants to the USA may have an impact on other analyzed variables such as birth rate and mortality. As well as their age and income structure can affect the target group of tertiary education graduates.

### 4.3 Delayed demand for tertiary education

Delay can be seen very often in the context of economic phenomena. Similar situation is with possibility to fulfil a group of tertiary students in terms of deferred demand. In practice, there are a number of reasons for postponing study at tertiary education institutions.

Empirical data for this variable do not exist for all selected economies. Only the Czech Republic is included in the study Eurostudent IV. It has got 20 % students with delayed demand for tertiary education in 2010 (Orr, Gwosć & Netz, 2011).

The majority states comprised in the study are EU member states. The median value of all 23 countries, has got a value of 13,5 % (Orr, Gwosć & Netz, 2011).

### 4.4 Verification of the hypothesis $H_{A0}$

The following article part is focused on the validation of defined hypotheses defined.

Hypothesis  $H_{A0}$  is determined as follows: “The number of tertiary education graduates in the whole economy rises in monitored period.”

Input data for the Tab. 1 are based on Eurostat statistics. The time series for the EU (27) lacked several data that has been calculated by using the program Statistica 10 using the imputation of values in rows. These data are in Tab. 1 marked in bold.

Tab. 1 - Development of the number of tertiary education of graduates for the period 2000-2009. Source: (Eurostat, 2013a), own processing.

	2000	2001	2002	2003	2004
Czech Rep.	41 034	47 178	54 341	59 256	69 312
USA	2 238 327	2 355 724	2 473 299	2 557 595	2 639 006
EU (26)	2 657 482	2 889 238	3 119 975	3 080 570	3 794 122
	2005	2006	2007	2008	2009
Czech Rep.	77 580	88 975	96 207	101 188	107 118
USA	2 704 070	2 782 270	2 881 557	2 997 614	3 164 951
EU (26)	3 893 278	4 115 733	<b>4 267 609</b>	<b>4 500 527</b>	4 629 934

As shown in Tab. 1, the development of tertiary education graduates in the Czech Republic, USA, showed an increasing trend represented by the geometric average annual growth values of 11,25 % for the Czech Republic and the USA 3,92 %. EU (26) occurred in 2003 to drop, but in other years, a growing number of graduates. The geometric average of the annual growth rates in these years amounted to nearly 6,36 %.

Tab. 2 - Changes in the number of tertiary education graduates in the period 2000-2009. Source: (Eurostat, 2013a), own processing.

	Absolut change (2009 – 2000)	Procentual change (2000 = 100%)
Czech Rep.	66 084	161,050
USA	926 624	41,401
EU (26)	1 972 452	74,233

Tab. 2 shows that the highest increase of tertiary education graduates during the reporting period has got the Czech Republic. In the second place is the EU (26), which is an increase in the number of graduates of tertiary education. The USA is third in the number of tertiary graduates.

Tab. 3 - Correlation between number of tertiary education graduates and population. Source: (Eurostat, 2013a), own processing.

	Correlation coefficient
Czech Rep.	0,650
USA	0,994
EU (26)	0,981

The values of the correlation coefficient for all surveyed economies in Tab. 3 confirmed a strong positive relationship between the development of tertiary education graduates and the number of inhabitants.

Tab. 4 - Geometric average annual growth rate for variables in the period 2000 – 2009. Source: (Eurostat, 2013a), (Worldbank, 2011), own processing.

	Population	Tertiary education graduates
Czech Rep.	0,182 %	11,251 %
USA	0,893 %	3,924 %
EU (26)	0,369 %	6,363 %

Tab. 4 includes variables within the hypothesis  $H_{A0}$ . It is evident that the USA noticed the fastest population increasing in the USA. Instead of this fact but its value is less than one percent. In comparison the number of graduates with tertiary education increases many times.

The absolute values of changes in the number of graduates of tertiary education in the majority of observed economic units increase. This growth is again necessary to convert on the unit because of comparability. For this purpose, the value of the indicator of tertiary education graduates per capita is calculated.



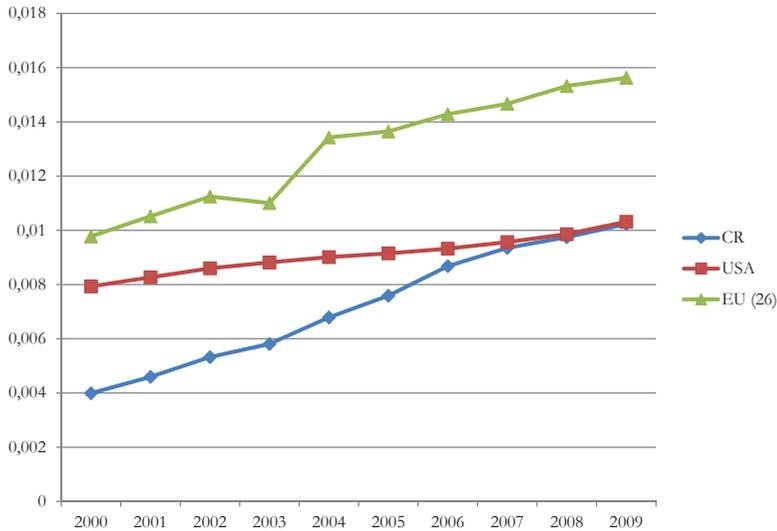


Fig. 1 - Indicator of tertiary education graduates per capita in the period 2000-2009. Source: (Eurostat, 2013a), (Worldbank, 2011), own processing.

Fig. 1 shows that a tertiary education graduate per capita has grown in all examined economies in period 2000 – 2009.

Tab. 5 - Results of regression analysis of the values of the time series of population and tertiary education graduates. Source: (Eurostat, 2013a), (World Bank, 2011), own processing.

	Regression model	Determination index (R <sup>2</sup> )	Regression equation
Czech Rep.	Linear	0,991	$y = 0,0007 x + 0,0032$
USA	Linear	0,914	$y = 0,0002 x + 0,0078$
EU (26)	Linear	0,953	$y = 0,0007 x + 0,0092$

In the Tab. 5 there are values for the equation elements of the regression lines. Element „a“ shows that the share of tertiary education per capita has grown the same way in the EU (26) as well as in the Czech Republic. Its value for the USA has increased 2.5 times slower than the EU (26) and the Czech Republic.

Now interim conclusion for the hypothesis  $H_{A0}$  can be stated. The total number of tertiary education graduates in selected economies has grown in the period 2000 – 2009. The same conclusions are found for the number of tertiary education graduates per capita. It follows that the validity of the hypothesis  $H_{A0}$  is verified for the Czech Republic, EU (26) and the USA.

#### 4.5 Verification of the hypothesis $H_{B0}$

Hypothesis  $H_{B0}$  is formulated, as follows: “With increasing of the tertiary education graduates number, number of researchers increases too in monitored period.”

Data of the total number of researchers have been taken from Eurostat statistics. Values in the time series for USA have been missing for years 2008 and 2009. These are calculated in the same way as in Tab. 1.

Tab. 6 - Total number of researchers in period 2000 – 2009, Source (Eurostat, 2013b), own processing.

	Absolut change (2009 – 2000)	Procentual change (2000 = 100%)
Czech Rep.	14 907	107,616
USA	166 967	12,907
EU (26)	440 372	40,757

Tab. 6 shows the largest procentual increase of researches in the Czech Republic. EU (26) has got also very good increase in comparison with the USA.

Tab. 7 - Correlation between tertiary education graduates and researchers. Source: (Eurostat, 2013a), (Eurostat, 2013b), own processing.

	Correlation coefficient
Czech Rep.	0,972
USA	0,915
EU (26)	0,994

Tab. 7 shows the correlation coefficient of tertiary education graduates and researchers. Correlation coefficient values are close to the 1. It can be concluded that the variables representing the number of tertiary education graduates and the number of researchers have very strong positive relationship for all selected economies.

Tab. 8 - Geometric average annual growth rates for the period 2000 – 2009. Source: Source: (Eurostat, 2013a), (Eurostat, 2013b), own processing.

	Tertiary education graduates	Researches
Czech Rep.	11,251 %	10,5077491
USA	3,924 %	1,26572147
EU (26)	6,363 %	4,0218468

Tab. 8 shows that the values of the geometric average growth rates of graduates are higher than the growth rate of the number of researchers in all selected economies.

Indicator of scientists to tertiary education graduates serves for the hypothesis  $H_{B0}$  verification.



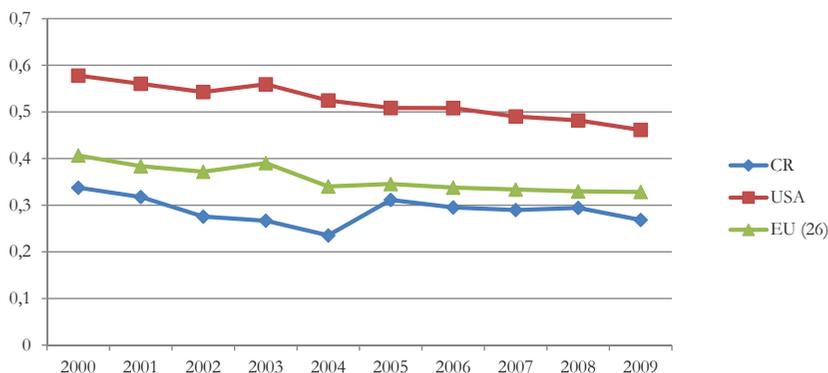


Fig. 2: Share of researchers to tertiary education graduates in the period 2000-2009. Source: (Eurostat, 2013a), (Eurostat, 2013b), own processing.

Fig. 2 shows that the share of researchers to tertiary education graduates has decreased for all selected economic in the period 2000 – 2009.

Tab. 9 - Results of regression analysis of the values of the time series of the researchers and tertiary education graduates. Source: Eurostat, 2013a), (Eurostat, 2013b), own processing.

	Regression model	Determination index (R <sup>2</sup> )	Regression equation
Czech Rep.	Polygon of 4th degree	0,669	$y = -9E-05x^4 + 0,0011x^3 + 0,0022x^2 - 0,052x + 0,392$
USA	Linear	0,954	$y = -0,0123x + 0,5892$
EU (26)	Linear	0,831	$y = -0,0086x + 0,4042$

The Tab. 9 shows that the proportion of researchers to tertiary education graduates has fallen in the USA and the EU (26). It has fallen 1, 4 times faster in the USA than in the EU (26). In the Czech Republic the determination index for the linear model is very low, therefore regression model in the form of a polygon of fourth degree has been chosen. Visually it is apparent decrease in Fig. 2.

Now interim conclusion for the hypothesis  $H_{B0}$  can be stated. The statement of hypothesis  $H_{B0}$  for EU (26), USA and the Czech Republic is rejected according to results of Tab. 8 and Tab. 9.

## 5. DISCUSSION

It can be stated that the number of graduates has grown faster than the population in selected economies. This growth should be even stronger if number of students with delayed demand decreases.

EU (26) and the Czech Republic have very slope increase of tertiary education graduates per capita. According to goals of EU Strategic document „EU 2020“it shall be strengthened. EU tertiary students have got also better condition for study in comparison with students in USA. It is perceptible from rising student debt in the USA. The Federal Reserve of New York estimates American student debt totals around 1 trillion USD. Europeans are graduating from college debt free or have many times lower tuition to nonexistent. It is mainly in a way of financing public universities from public resources with none or low student fees (Scott, 2013). These all facts are assumptions for next positive trend of the tertiary graduates' number in EU (26) and the Czech Republic.

Quantitative fulfillment of tertiary education absolvents number can be considered as none or very low threats. Issue of this tertiary education absolvent's quality is very important, because of their possibility to success in the labor market and their ability for scientific work.

Moreover there is necessary to influence number of tertiary students in study programs. From the practice of the Czech Republic, there is well known lack of tertiary students of technical fields. It has negative consequences in the labor market, where is lack of labor with this qualification requirements and surplus of absolvents with humanistic education (e.g. historians, philosophers and lawyers).

Hypothesis HB0 is rejected for the EU (26), the Czech Republic as well as for the USA. It implicates that tertiary education graduates have not become researchers in period of 2000 -2009. Moreover the geometric average annual growth rates of tertiary education graduates and the number of researchers for the period 2000-2009, shows rapid growth in the number of graduates than scientists especially in EU (26) and USA. The Czech Republic has got almost comparable pace of both variables.

It brings very fascinated issue of which people (age, field and researchers net mobility) is fulfilled the most number of researchers. It deserves another analysis in continuation of human sources for R&D.

It is clear that tertiary education graduate's majority cannot become researchers. But it can be assumed that for preservation of inflow for number of researches, the ratio between tertiary education graduates and researchers should grow or be at least constant in a worst case.

## 5.1 Recommendations for increase number of researches

The base for potential researches consists of tertiary education graduates. Tertiary education graduates should have better assumptions to become and work as researcher among other groups of population. Some recommendations are proposed here in order to contribute increasing number of researchers from tertiary education graduates group.

General recommendation should be to reform the whole system of education in a way of stimulate desire for exploring and obtaining knowledge with own effort and creativity.

In terms of setting conditions for tertiary graduate to become a scientist, are important innate abilities and skills. These capabilities and skills are needed to further develop education and training. The aim should be to achieve self-reliance and practical application of acquired knowledge.

Achieving these goals can be quantified by using appropriate indicator. Functional literacy is very useful and internationally recognized one. It consists of literary, documentary and numerical literacy. The international testing the levels of functional literacy called International Adult Literacy Survey are subsequently presented statistical data (Kirsch, 2001; Organization for Economic Cooperation and Development 2013a).

The motivation for graduates to become a scientist is important too. It may have been in progress in the study of secondary and should increase at the tertiary level of education. It should be done by teaching special seminars, e.g. science popularization. Teachers should also find out talented students with potential for scientific work in their classes and pay them special attention in subject, in which these students are interested in (e.g. give them more study materials or recommend books for extending knowledge in certain fields, projects).

Especially doctoral studies and its support is very important, because these graduates are supposed to have practice with scientific work and should be interested in further research activities.

In terms of deciding on a career researcher can pick up opportunity costs. It can be represented with labor remuneration, benefits or social status. Tertiary education graduates with research potential can due to the high cost sacrificed opportunities in the form of higher wages or the career growth choose another non-researcher occupation.

Recommendation should be to create career system in research organizations and system of financing, which takes into account inter alia funds for researcher wages. Very important is to make better known, how useful and necessary is scientific work and its results. This should help to increase appreciation of researchers' occupation by society and its prestige as well.

## 6. CONCLUSION

The need of human resources is set by theoretical model of the new economy and goals of the EU Strategic documents. Moreover human sources have become very important for strengthening competitiveness in the knowledge economy via its abilities in working process and R&D. Through the last decade there has been increasing R&D importance for developed economies. These economies can be considered EU, USA and the Czech Republic, which are analyzed and compared in this article. These are starting points for the purpose of this article, which is trend analysis of human resources, which are supposed to create base for researchers.

Analysis tools such as correlation analysis showed a strong functional relationship between the variables entering both hypotheses. Regression analysis of the time series ratio values has shown increasing proportion of graduates with tertiary education per capita in all selected economies. This is a positive prerequisite for the fulfillment of the target group of researches.

Regression analysis of the time series ratio values has shown the number of scientists per tertiary graduate absolvents has decreased. This trend is seen as negative, therefore some recommendations are proposed in the article.

Issue of human resources for researchers implies next research. Within the future it would be useful to find out motivation of tertiary education absolvents to become researchers.

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## Contact information

Ing. Tomáš Lelek, Ph.D.

University of Pardubice, Faculty of Economics and Administration,

Studentská 84, 53210 Pardubice, Czech Republic

Email: [tomas.lelek@upce.cz](mailto:tomas.lelek@upce.cz)

